Amendments to the Claims

1. (currently amended) A communication system that processes data-carrying signals, the system comprising:

an array of antennas that is partitioned into subarrays;

a plurality of subarray beamformers;

a plurality of frequency converters that each couple a respective one of said subarray beamformers to a respective one of said subarrays and each alter the frequency of data-carrying signals associated with its respective subarray; and

an array beamformer coupled to said subarray beamformers;

wherein,

each of said subarray beamformers is configured to process respective data-carrying signals to correspond to a subarray antenna beam of its respective subarray; and

said array beamformer is configured to process respective data-carrying signals to correspond to an array antenna beam of said array;

said data-carrying signals thereby processed progressively to reduce computational complexity of said system;

<u>and further including a delay associated with each of said subarray beamformers and positioned to provide at least one delay path for routing of respective data-carrying signals to thereby provide delayed data-carrying signals;</u>

<u>wherein each subarray beamformer is configured to process said data-carrying signals and said delayed data-carrying signals to correspond to a respective antenna beam of said subarray;</u>

<u>and wherein said data-carrying signals include symbols that have a symbol time duration and said delay provides a time delay that is selectable between a portion of a symbol time duration and a plurality of symbol time durations.</u>

2. (original) The system of claim 1, wherein each of said subarray beamformers and said array beamformer are further configured to modify respective data-carrying signals with complex weights to thereby approximate a predetermined data-carrying signal.

3. (original) The system of claim 1, further including a modem coupled to said array beamformer to demodulate data from data-carrying signals of said array beamformer and to modulate data onto data-carrying signals of said array beamformer.

4. (original) The system of claim 1, further including a plurality of preprocessors that are each inserted between a respective one of said frequency converters and a respective one of said subarray beamformers to process said data-carrying signals with at least one of the processes of gain control, frequency correction, framing and time-of-arrival estimation, establishment of a sampling rate, time adjustment, channel correction, frequency domain transformation, downconversion, filtering, subsampling, and direct sequence de-spreading.

5. (original) The system of claim 1, further including a plurality of preprocessors that are each inserted between a respective one of said frequency converters and a respective one of said subarray beamformers to process said data-carrying signals with at least one of the processes of frequency translation, time domain transformation, upconversion, interpolation, frequency correction, direct sequence spreading, analog conversion, and filtering.

6. (original) The system of claim 1, wherein said subarray beamformers and said array beamformer are realized with at least one of an array of logic gates and an appropriately-programmed digital processor.

7. (original) The system of claim 1, wherein each of said frequency converters comprises a receiver.

8. (original) The system of claim 1, wherein each of said frequency converters comprises a transmitter.

9. (original) The system of claim 1, wherein each of said frequency converters comprises a transceiver.

10. (currently amended) [[A]] The ~~communication~~ system of claim 14, wherein said beamformer is configured to process said delayed data-carrying signals to regain information contained in non-coherent delays of said current data-carrying signals ~~that processes data-carrying signals, the system comprising: an array of antennas; a preprocessor; a frequency converter coupled between said array and said preprocessor to alter the frequency of data-carrying signals associated with said array; a modem; a beamformer coupled to exchange current data-carrying signals with said preprocessor and said modem; and a delay positioned to provide at least one delay path for routing of said current data-carrying signals to thereby provide delayed data-carrying signals to said beamformer; wherein said beamformer is configured to process said current data-carrying signals and said delayed data-carrying signals to correspond to an antenna beam of said array~~.

11. (currently amended) The system of claim 14 ~~10~~, wherein said delay is coupled between said preprocessor and said beamformer to establish said delay path.

12. (currently amended) The system of claim 14 ~~10~~, wherein said delay is coupled about said beamformer to establish said delay path.

13. (currently amended) The system of claim 14 ~~10~~, wherein said delay provides a selectable time delay.

14. (currently amended) ~~The~~ A communication system that processes data-carrying signals ~~of claim 10~~, the system comprising:

an array of antennas;

a preprocessor;

a frequency converter coupled between said array and said preprocessor to alter the frequency of data-carrying signals associated with said array;

a modem;

a beamformer coupled to exchange current data-carrying signals with said preprocessor and said modem; and

a delay positioned to provide at least one delay path for routing of said current data-carrying signals to thereby provide delayed data-carrying signals to said beamformer;

wherein said beamformer is configured to process said current data-carrying signals and said delayed data-carrying signals to correspond to an antenna beam of said array;

and wherein said data-carrying signals include symbols that have a symbol time duration and said delay provides a time delay that is selectable between a portion of a symbol time duration and a plurality of symbol time durations.

15. (currently amended) The system of claim 14 ~~10~~, wherein said beamformer is further configured to modify respective data-carrying signals with complex weights to thereby approximate a predetermined data-carrying signal.

16. (currently amended) The system of claim 14 ~~10~~, wherein said modem is configured to demodulate data from data-carrying signals of said beamformer and to modulate data onto data-carrying signals of said beamformer.

17. (currently amended) The system of claim 14 ~~10~~, wherein said preprocessor is configured to process said data-carrying signals with at least one of the processes of gain control, frequency correction, framing and time-of-arrival estimation, establishment of a sampling rate, time adjustment, channel correction, frequency domain transformation, downconversion, filtering, subsampling, and direct sequence de-spreading.

18. (currently amended) The system of claim 14 ~~10~~, wherein said preprocessor is configured to process said data-carrying signals with at least one of the processes of frequency translation, time domain transformation, upconversion, interpolation, frequency correction, direct sequence spreading, analog conversion, and filtering.

19. (currently amended) The system of claim 14 ~~10~~, wherein said beamformer is realized with at least one of an array of logic gates and an appropriately-programmed digital processor.

20. (currently amended) The system of claim 14 ~~10~~, wherein said frequency converter comprises a receiver.

21. (currently amended) The system of claim 14 ~~10~~, wherein said frequency converter comprises a transmitter.

22. (currently amended) The system of claim 14 ~~10~~, wherein said frequency converter comprises a transceiver.

23. (original) A communication system that processes data-carrying signals, the system comprising:

an array of antennas;

a preprocessor;

a frequency converter coupled between said array and said preprocessor to alter the frequency of data-carrying signals associated with said array; and

a beamformer coupled to said preprocessor;

wherein;

said preprocessor receives said data-carrying signals and provides corresponding time-of-arrival signals to said beamformer; and

in response to said time-of-arrival signals, said beamformer is configured to;

a) form a covariance matrix from a first set of data-carrying signals whose times-of-arrival at said array are within a predetermined time window;
b) invert said covariance matrix to obtain an inverted covariance matrix;
c) form a correlation matrix from said first set and a second set of predetermined signals;
d) multiply said inverted covariance matrix and said correlation matrix to thereby determine a plurality of weights; and
e) process said first set with said weights to obtain processed signals that correspond to a plurality of antenna beams of said array.

24. (original) The system of claim 23, wherein said beamformer is further configured to maximally combine said processed signals to optimize a performance parameter.

25. (original) The system of claim 23, wherein said data-carrying signals are modulated in accordance with orthogonal frequency division multiplexing and said predetermined time window is a guard interval.

26. (original) The system of claim 23, wherein said data-carrying signals contain tones and said beamformer is further configured to apply phase shifts that conform tones of said second set to said predetermined time window.

27. (original) The system of claim 23, further including a modem coupled to said beamformer to demodulate data from said data-carrying signals.

28. (original) The system of claim 23, wherein said frequency converter comprises a receiver.

29. (currently amended) A method of processing data-carrying signals in a communication system, comprising the steps of:

converting the frequency of data-carrying signals that are associated with each subarray of an array of antennas;

for each subarray, processing respective data-carrying signals to correspond to a subarray antenna beam of that subarray; and

for said array, processing respective data-carrying signals to correspond to an array antenna beam of said array;

processing of said data-carrying signals thereby realized progressively to reduce computational complexity of said system;

wherein said subarray processing step includes the steps of:

converting the frequency of current data-carrying signals that are associated with that subarray;

routing at least part of said current data-carrying signals through at least one delay path to provide delayed data-carrying signals; and

processing said current data-carrying signals and said delayed data-carrying signals to correspond to an antenna beam of said array wherein this processing step includes the step of processing said delayed data-carrying signals to regain information contained in non-coherent delays of said current data-carrying signals.

30. (original) The method of claim 29, wherein said processing steps each include the step of modifying respective data-carrying signals with complex weights to thereby approximate a predetermined data-carrying signal.

31. (original) The method of claim 29, further including the steps of: demodulating data from data-carrying signals of said array beamformer; and modulating data onto data-carrying signals of said array beamformer.

32. (original) The method of claim 29, further including the step of processing said data-carrying signals with at least one of the processes of gain control, frequency correction, framing and time-of-arrival estimation, establishment of a sampling rate, time adjustment, channel correction, frequency domain transformation, downconversion, filtering, subsampling, and direct sequence de-spreading.

33. (original) The method of claim 29, further including the step of processing said data-carrying signals with at least one of the processes of frequency translation, time domain transformation, upconversion, interpolation, frequency correction, direct sequence spreading, analog conversion, and filtering.

34. (original) The method of claim 29, wherein said converting step includes the step of receiving said data-carrying signals.

35. (original) The method of claim 29, wherein said converting step includes the step of transmitting said data-carrying signals.

36. (currently amended) [[A]] The method of claim 37, wherein said current data-carrying signals include symbols that have a symbol time duration and said routing step includes the step of configuring said delay path to provide time delays that are selectable between a portion of a symbol time duration and a plurality of symbol time durations ~~processing data-carrying signals in a communication system, comprising the steps of: converting the frequency of current data-carrying signals that are associated with an array of antennas; routing at least part of said current data-carrying signals through at least one delay path to provide delayed data-carrying signals to said beamformer; and processing said current data-carrying signals and said delayed data-carrying signals to correspond to an antenna beam of said array~~.

37. (currently amended) ~~The~~ A method of processing data-carrying signals in a communication system ~~claim 36~~, comprising the steps of:

converting the frequency of current data-carrying signals that are associated with an array of antennas;

routing at least part of said current data-carrying signals through at least one delay path to provide delayed data-carrying signals; and

processing said current data-carrying signals and said delayed data-carrying signals to correspond to an antenna beam of said array;

wherein said processing step includes the step of processing said delayed data-carrying signals to regain information contained in non-coherent delays of said current data-carrying signals.

38. (currently amended) The method of claim 37 ~~36~~, wherein said processing steps each include the step of modifying respective data-carrying signals with complex weights to thereby approximate a predetermined data-carrying signal.

39. (currently amended) The method of claim 37 ~~36~~, further including the steps of:

demodulating data from data-carrying signals of said array beamformer; and

modulating data onto data-carrying signals of said array beamformer.

40. (currently amended) The method of claim 37 ~~36~~, further including the step of processing said data-carrying signals with at least one of the processes of gain control, frequency correction, framing and time-of-arrival estimation, establishment of a sampling rate, time adjustment, channel correction, frequency domain transformation, downconversion, filtering, subsampling, and direct sequence de-spreading.

41. (currently amended) The method of claim 37 ~~36~~, further including the step of processing said data-carrying signals with at least one of the processes of frequency translation, time domain transformation, upconversion, interpolation, frequency correction, direct sequence spreading, analog conversion, and filtering.

42. (currently amended) The method of claim 37 ~~36~~, wherein said converting step includes the step of receiving said data-carrying signals.

43. (currently amended) The method of claim 37 ~~36~~, wherein said converting step includes the step of transmitting said data-carrying signals.

44. (currently amended) A method of processing data-carrying signals in a communication system, comprising the steps of:

forming a covariance matrix from a first set of data-carrying signals whose times-of-arrival at an array of antennas are within a predetermined time window ~~interval~~;

inverting said covariance matrix to obtain an inverted covariance matrix;

forming a correlation matrix from said first set and a second set of predetermined signals;

multiplying said inverted covariance matrix and said correlation matrix to thereby determine a plurality of weights; and

processing said first set with said weights to obtain processed signals that correspond to a plurality of antenna beams of said array.

45. (original) The method of claim 44, wherein said processing step further includes the step of maximally combining said processed signals to optimize a performance parameter.

46. (original) The method of claim 44, wherein said processing step further includes the step of applying phase shifts to equalize said first set.

47. (original) The method of claim 44, wherein said data-carrying signals are modulated in accordance with orthogonal frequency division multiplexing and said predetermined time window is a guard interval.

48. (original) The method of claim 44, wherein said data-carrying signals contain tones and further including the step of applying phase shifts that conform tones of said second set to said predetermined time window.

49. (original) The method of claim 44, further including the step of demodulating data from said data-carrying signals.

50. (original) The method of claim 49, further including the step of processing said data-carrying signals with at least one of the processes of gain control, frequency correction, framing and time-of-arrival estimation, establishment of a sampling rate, time adjustment, channel correction, frequency domain transformation, downconversion, filtering, subsampling, and direct sequence de-spreading.